Pointing gestures in sign language: Variations, interpretations and recognition

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Variability appears in communication process over these steps: conception, enunciation, perception and interpretation. This is also true for the sign language.

Conception results in the mental space of the speaker, which guides him to perform his speech notably by organizing entities and their relations. Sign language discourses handle illustrative and non-illustrative intents. Both engender variations in discourse **enunciation**. For example, the signer may or may not use facial expressions to perform personal transfer. Sign language is multi channel. So, during the generation of utterance, there are many possibilities of gesture combinations for illustrative production such as entity referencing. The signing space represents the **interpretations** of **perceived** gestures. It is composed of entities attached to the discourse. In the referencing case, the signer has kept in his mind the relevant zones of the space, which are related to the discourse, and then points to one of these locations. On the other hand, the addressee perceives pointing gesture and understands relation between the referenced location and its corresponding discursive element. However, we have noticed problems of movement **perception** due to the capture environment. For example, gaze orientation, which plays an important role in sign language understanding, is difficult to perceive.

In this study, we will focus on pointing gestures combinations by analyzing manual and non-manual ones. Our study is composed of a temporal analysis of delay variations between movements and a spatial analysis of head, hand, and gaze three-dimensional positions. We consider the pointing gesture as a manual and/or non-manual gesture directed to a particular zone, which represents a discursive element location.

In order to characterize the chronological order of pointing gesture, we consider a set of five minutes annotated videos. We extract the most frequent pointing gesture combinations, which are composed of shoulders, head and gaze movements. These gestures point to different zones. We found out a common delay of 400 milliseconds between the beginning of gaze and head movements and between the head and the shoulders movements. In order to validate this combination as a basic pattern of pointing gesture, a corresponding pattern filter is applied to another set of videos. Then, to make a pseudo-model of pointing gesture, which takes into account the difficulty of gaze perception, we applied a modified pattern filter composed of only head and shoulder movements. By comparing the results of the two detections, we conclude that system detection should include both methods to get optimal performance and reliability.

In order to characterize the spatial combination of pointing gestures, we build a geometric model and apply it to three-dimensional corpus. We measure distances between entities and hand positions, then between entities and face directions. Measures show that manual pointing gestures have the same behaviour when are towards the same entity and present varied behaviour (less predictable) when pointing to two entities. The head has different behaviours even when pointing to the same entity. We conclude that there is a spatial relation between entity positions and the behaviour of manual gestures that point towards them.

This study shows that, despite of temporal and spatial variations, we can built and validate a temporal pattern and a geometric model of pointing gesture using its linguistic functional value – the location of the discursive entity.

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